APPENDIX E

TEST REQUIREMENTS MATRIX

Appendix E-1 Test Requirements Matrix

PARAGRAPH	DESCRIPTION	VERIFICATION TESTS
F.2.1.1.1.1	**STIS Configuration States.** The ground system shall support the specification and scheduling of **Space Telescope Imaging Spectrograph (**STIS**)** configuration state transitions for all **nominal** instrument and detector configuration states.	**SMGT-24 and 28**
F.2.1.1.1.2.**1**	**Multi-Anode Microchannel Array (MAMA) Accumulate-Over-Time Mode.** The ground system shall support the **implementation of stored commanding capabilities (proposal processing, SMS generation, command load generation) of STIS observations for the Multi-Anode Microchannel Array (MAMA) accumulate-over-time mode**. (**f**ull **f**rame **and subarray data format**)	**SMGT-24 and 28**
F.2.1.1.1.2.**2**	**CCD Accumulate-Over-Time Mode.** The ground system shall support the **implementation of stored commanding capabilities (proposal processing, SMS generation, command load generation) of STIS observations for the CCD accumulate-over-time mode. (full-frame and subarray data format)**	**SMGT-24 and 28**
F.2.1.1.1.2.**3**	**MAMA Time Resolved Mode (Time Tag).** The ground system shall support the **implementation of stored commanding capabilities (proposal processing, SMS generation, command load generation)** of STIS observations for **the MAMA time resolved mode (time tag). (full-frame and subarray data format)**	**SMGT-24 and 28**

F.2.1.1.1.2.**4**	**STIS Engineering Diagnostic Mode**. The ground system shall support the **implementation of special test procedures for the use of the** STIS **engineering diagnostic mode.**	**SMGT-24 and 28**
F.2.1.1.1.2.**5**	**Target Acquisition.** The ground system shall support the **implementation of stored commanding capabilities (proposal processing, SMS generation, command load generation) of STIS observations for target acquisition, including isolated point source, diffuse source, crowded field, and coronagraphic acquisitions.**	**SMGT-24 and 28**
F.2.1.1.1.2.**6**	**Alignment Mode.** The ground system shall support the **implementation of stored commanding capabilities (proposal processing, SMS generation, command load generation) of STIS observations for the alignment mode.**	SMGT-24 and 28
F.2.1.1.1.2.**7**	**STIS Science Data Management Within the CS Buffer Memory. The ground system shall support the implementation of stored commanding capabilities (proposal processing, SMS generation, command load generation) of STIS observations for science data management (accumulation, storage, and readout of science data) within the CS buffer memory.**	**SMGT-24 and 28**
F.2.1.1.1.3	**STIS Operating Constraints and Restrictions.** The ground system shall support the implementation of STIS operating constraints and restrictions during science operations planning and scheduling activities. **The STIS operational constraints and restrictions will be documented in SMO-1020.**	**Card Implementation Plan (SMO-1050)**

F.2.1.1.2.1	**NICMOS Configuration States.** The ground system shall support the specification and scheduling of **the Near Infrared Camera and Multi-Object Spectrometer (**NICMOS**) configuration** state transitions for all nominal instrument and detector configuration states.	**SMGT-25 and 28**
F.2.1.1.2.2.1	**Accum Mode**. The ground system shall support the **implementation of stored commanding capabilities (proposal processing, SMS generation, command load generation) of NICMOS observations for the accum** mode.	**SMGT-25 and 28**
F.2.1.1.2.2.2	**Ramp Mode.** The ground system shall support the **implementation of stored commanding capabilities (proposal processing, SMS generation, command load generation) of NICMOS observations for the ramp** mode.	**SMGT-25 and 28**
F.2.1.1.2.2.3	**Target Acquisition Mode**. The ground system shall support the **implementation of stored commanding capabilities (proposal processing, SMS generation, command load generation) of NICMOS observations for the target acquisition** mode.	**SMGT-25 and 28**
F.2.1.1.2.2.4	**Alignment Mode**. The ground system shall support the **implementation of stored commanding capabilities (proposal processing, SMS generation, command load generation) of NICMOS observations for the alignment** mode.	**SMGT-25 and 28**
F.2.1.1.2.2.5	**Bright Object Mode.** The ground system shall support the **implementation of stored commanding capabilities (proposal processing, SMS generation, command load generation) of NICMOS observations for the bright object** mode.	**SMGT-25 and 28**
F.2.1.1.2.2.6	**Multi-accum Mode**. The ground system shall support the **implementation of stored commanding capabilities (proposal processing, SMS generation, command load generation) of NICMOS observations for the multi-accum mode.**	**SMGT-25 and 28**

F.2.1.1.2.2.7	**Concurrent Camera Operations**. The ground system shall support the **implementation of stored commanding capabilities (proposal processing, SMS generation, command load generation) of NICMOS observations for concurrent camera operations.**	**SMGT-25 and 28**
F.2.1.1.2.2.8	**NICMOS Science Data Management Within the CS Buffer Memory**. The ground system shall support the **implementation of stored commanding capabilities (proposal processing, SMS generation, command load generation) of NICMOS observations for science data management (accumulation, storage, and readout of science data) within the CS buffer memory.**	**SMGT-25 and 28**
F.2.1.1.2.2.9	**NICMOS Engineering Diagnostic Mode. The ground system shall support the implementation of special test procedures for the use of the NICMOS engineering diagnostic mode.**	**SMGT-25 and 28**
F.2.1.1.2.3	**NICMOS Operating Constraints and Restrictions**. The ground system shall support the implementation of NICMOS operating constraints and restrictions during science operations planning and scheduling activities. **The NICMOS operational constraints and restrictions will be documented in SMO-1020.**	**Card Implementation Plan (SMO-1050)**
F.2.1.1.3.1.1	**SSR and ESTR Science Data. The ground system shall support the configuration of the SSR and ESTR in any combination for recording and replay of science data.**	**SMGT-22,23,27,32**
F.2.1.1.3.1.2	**SSR and ESTR Engineering Data. The ground system shall support the configuration of the SSR and ESTR in any combination for recording and replay of engineering data.**	**SMGT-22,23,27,32**
F.2.1.1.3.1.3	**SSR and ESTR Safemode Data. The ground system shall support the configuration of the SSR and ESTR in any combination for recording and replay of safemode data.**	**SMGT-22,23,27,32**

F.2.1.1.3.1.4	**Location of SSR. The ground system shall support the SSR installed in any of the three ESTR locations.**	**SMGT-22,23,27,32**
F.2.1.1.3.2.1	**SSR OFF Mode. The ground system shall support the implementation of stored commanding capabilities (proposal processing, SMS generation, command load generation) and real-time telemetry and command operations to support the SSR OFF mode.**	**SMGT-27,32**
F.2.1.1.3.2.2	**SSR Standby Mode. The ground system shall support the implementation of stored commanding capabilities (proposal processing, SMS generation, command load generation) and real-time telemetry and command operations to support the SSR Standby mode.**	**SMGT-27,32**
F.2.1.1.3.2.3	**Recording Speeds on SSR and ESTR. The ground system shall support the implementation of stored commanding capabilities (proposal processing, SMS generation, command load generation) and real-time telemetry and command operations to support the 4, 32, and 1024 Kbps recording on the SSR as well as the ESTR.**	**SMGT-22,23,27,32**
F.2.1.1.3.2.4	**Simultaneous Record and Playback. The ground system shall support the implementation of stored commanding capabilities (proposal processing, SMS generation, command load generation) and real-time telemetry and command operations to support the simultaneous record and playback operations using a mix of ESTRs and SSRs or two SSRs in parallel.**	**SMGT-22,23, 27,32**

F.2.1.1.3.2.5	**Ground Processing of Bit stuffed and Non-Bit Stuffed Data. The ground system shall support the implementation of stored commanding capabilities (proposal processing, SMS generation, command load generation) and real-time telemetry and command operations to support the ground processing of non-bit stuffed science and engineering data as well as maintaining the current capability of bit stuffed science and engineering data.**	**SMGT-22,23, 27,32**
F.2.1.1.3.2.6	**Forward and Reverse Playbacks. The ground system shall support the implementation of stored commanding capabilities (proposal processing, SMS generation, command load generation) and real-time telemetry and command operations to support the forward directional playback of data [First in, First out (FIFO)] from the SSR as well as reverse directional playbacks of ESTRs [Last in, Last out (LIFO)].**	**SMGT-22,23,27,32**
F.2.1.1.3.3	**SSR Operating Constraints and Restrictions. The ground system shall support the implementation of SSR operating constraints and restrictions that shall be identified for SSM operations. The SSR operational constraints and restrictions will be documented in SMO-1020.**	**Card Implementation Plan (SMO-1050)**
F.2.1.1.3.4.1	**SSR Generic Criteria. The SSR generic criteria shall allow for a minimum number of playback contacts spaced at a defined interval for the science data. The parameters that drive this method shall be adjustable.**	**SMGT-22,23,27,32**
F.2.1.1.3.4.2	**SSR Volume Criteria. The SSR volume criteria shall allow for the scheduling of playback contacts based on the volume of data recorded. The parameters that drive this method shall be adjustable.**	**SMGT-22,23,32**

F.2.1.1.3.4.3	**SSR Combined Mode. The ground system shall support a SSR combined mode where the generic criteria is used but a determination is made as to the adequacy of the generic contacts based on the volume of data. Additional contacts may be scheduled based on the volume of data.**	**SMGT-22,23,32**
F.2.1.1.3.4.4	**Recording of Science and Engineering Data to the SRR. When both science and engineering data are recorded to the SSR, the ground system shall establish a precedence for scheduling playbacks of data such that data is not lost and the playback of engineering data and science data do not interfere with each other or with the recording of engineering data.**	**SMGT-22,23,32**
F.2.1.2.1.1.1	**STIS NSSC-1 Macro AP**. The ground system shall support stored and real-time commanding**, with parameters up to 32 bits in length,** through the STIS NSSC-1 MACRO AP.	SMGT-24
F.2.1.2.1.1.2	**STIS RIU**. The ground system shall support real-time commanding through the STIS RIU.	SMGT-24
F.2.1.2.2.1.1	**NICMOS NSSC-1 Macro AP**. The ground system shall support stored and real-time commanding, **with parameters up to 32 bits in length,** through the NICMOS NSSC-1 macro AP.	SMGT-25
F.2.1.2.2.1.2	**NICMOS RIU**. The ground system shall support real-time commanding through the NICMOS RIU.	SMGT-25
F.2.1.2.3.1.1	**SSR Stored Commanding. The ground system shall support SSR stored commanding through the SSM and NSSC-I FSW via appropriate command routing from the SSM FSW through the Processor Interface Table (PIT) to the NSSC-I FSW for science data records and through the appropriate SSM DIUs for engineering and safemode data records.**	**SMGT-23,32**

F.2.1.2.3.1.2	**SSR Real-time Commanding. The ground system shall support SSR real-time commanding through the PRS system via the SSM Command Data Interface (CDI) with appropriate command routing through the SSM DIUs and FSW command handler.**	**SMGT-23,27,32**
F.2.1.2.4.1	**FGS Actuator Mechanism Subsystem (AMS) Command Interfaces. The ground system shall support the implementation of all FGS AMS command interfaces. This support shall include real-time commanding only.**	**SMGT-34**
F.2.1.3.1.1.1	**Location of STIS Code.** The ground system shall support the management of STIS FSW and microprocessor memory to maintain information on the location of code.	SMGT-**23,24**
F.2.1.3.1.1.2	**Location of STIS Macros.** The ground system shall support the management of STIS FSW and microprocessor memory to maintain information on the location of Macros.	SMGT-**23,24**
F.2.1.3.1.1.3	**Location and Contents of STIS Data Tables.** The ground system shall support the management of STIS FSW and microprocessor memory to maintain information on the location and contents of data tables.	SMGT-**23,24**
F.2.1.3.1.1.4	**Location of Bad STIS Memory Areas.** The ground system shall support the management of STIS FSW and microprocessor memory to maintain information on the location of bad memory areas within the STIS microprocessor memory.	SMGT-**23,24**
F.2.1.3.1.1.5	**Process STIS Software Memory Loads.** The ground system shall support the management of STIS FSW and microprocessor memory to process software memory loads delivered by the **responsible** Flight Software Maintenance Group **and uplink to any area of STIS memory (i.e. Buffer Storage, EEPROM, EDAC or MIE).**	SMGT-21,**22,23,24**

F.2.1.3.1.1.6	**Load STIS Flight Software Updates.** The ground system shall support the management of STIS FSW and microprocessor memory **to generate the commanding necessary to load the FSW updates within STIS and to verify the modified memory locations through checksum tests.**	SMGT-**23,24**
F.2.1.3.1.1.7	**Collect STIS Memory Dumps.** The ground system shall support the management of STIS FSW and microprocessor memory to collect **STIS memory dumps and make this data available to the responsible Flight Software Maintenance Group, the Flight Operations Team, and the STScI.**	SMGT-21,**22,24**
F.2.1.3.1.1.8	**Generate STIS Formatted Reports.** The ground system shall support the management of STIS FSW and microprocessor memory **to generate formatted reports of software memory loads.**	SMGT-21,**22,24**
F.2.1.3.1.2.1	**STIS Letter Code.** The ground system shall support the STIS **subsystem /element** letter code 'O'.	SMGT-21,**22,23,24**
F.2.1.3.1.2.2	**STIS Source ID.** The ground system shall support the STIS **Source ID of 8-bits in length (256 unique values) and** Source ID parity. **The science instrument Source ID specifications are defined in the ST-ICD-08 Unique Appendices.**	SMGT-21,**22,23,24**
F.2.1.3.1.2.3	**STIS Format Codes.** The ground system shall support the STIS format codes.	SMGT-21,**22,23,24**
F.2.1.3.1.3	**STIS Health and Safety.** The ground system shall support the implementation of STIS operating constraints and restrictions **during real-time operations. The STIS operational constraints and restrictions are documented in SMO-1020.**	
F.2.1.3.1.3.1	**STIS Safing Steps.** The ground system shall support the implementation of STIS safing steps.	SMGT-2**2,23,24**

F.2.1.3.1.3.2	**STIS Safing Procedures.** The ground system shall support the implementation of STIS safing procedures.	SMGT-**22,23,24**
F.2.1.3.1.3.3	**STIS Limits.** The ground system shall support the implementation of STIS limits.	SMGT-**22,23,24**
F.2.1.3.2.1.1	**Location of NICMOS Code.** The ground system shall support the management of NICMOS FSW and microprocessor memory to maintain information on the location of code.	SMGT-**23,**25
F.2.1.3.2.1.2	**Location of NICMOS Macros.** The ground system shall support the management of NICMOS FSW and microprocessor memory to maintain information on the location of Macros.	SMGT-**23,**25
F.2.1.3.2.1.3	**Location and Contents of NICMOS Data Tables.** The ground system shall support the management of NICMOS FSW and microprocessor memory to maintain information on the location and contents of data tables.	SMGT-**23,**25
F.2.1.3.2.1.4	**Location of Bad NICMOS Memory Areas. The ground system shall support the management of NICMOS FSW and microprocessor memory to maintain information on the location of bad memory area**s within **the NICMOS microprocessor** memory.	SMGT-**23,**25
F.2.1.3.2.1.5	**Process NICMOS Software Memory Loads.** The ground system shall support the management of NICMOS FSW and microprocessor memory to process software memory loads delivered by the responsible Flight Software Maintenance Group and uplink to any area of NICMOS memory **(i.e. Buffer Storage, EEPROM, EDAC or MIE).**	SMGT-**23,**25
F.2.1.3.2.1.6	**Load NICMOS Flight Software Updates.** The ground system shall support the management of NICMOS FSW and microprocessor memory to generate the commanding **necessary** to load the FSW updates **within NICMOS and** to verify the modified memory locations through checksum tests.	SMGT-**23,**25

F.2.1.3.2.1.7	**Collect NICMOS Memory Dumps.** The ground system shall support the management of NICMOS FSW and microprocessor memory **to** collect **NICMOS** memory dumps and make **this data** available to the **responsible Flight Software Maintenance Group, the Flight Operations Team,** and the STScI.	SMGT-21,22,25
F.2.1.3.2.1.8	**Generate NICMOS Formatted Reports.** The ground system shall support the management of NICMOS FSW and microprocessor memory to generate formatted reports of software memory loads.	SMGT-21,**22,**25
F.2.1.3.2.2.1	**NICMOS Letter Code.** The ground system shall support the NICMOS subsystem/element letter code 'N'.	SMGT-21,**22,23,25**
F.2.1.3.2.2.2	**NICMOS Source ID.** The ground system shall support the NICMOS Source ID **of 8-bits in length (256 unique values)** and Source ID parity. **The science instrument Source ID specifications are defined in the ST-ICD-08 Unique Appendices.**	SMGT-21,**22,23,25**
F.2.1.3.2.2.3	**NICMOS Format Codes.** The ground system shall support the NICMOS format codes.	SMGT-21,**22,23,25**
F.2.1.3.2.3	**NICMOS Health and Safety.** The ground system shall support the implementation of NICMOS operating constraints and restrictions **during real-time operations. The NICMOS operational constraints and restrictions will be documented in SMO-1020.**	**Card Implementation Plan (SMO-1050)**
F.2.1.3.2.3.1	**NICMOS Safing Steps.** The ground system shall support the implementation of NICMOS safing steps.	SMGT-**22,23,25**
F.2.1.3.2.3.2	**NICMOS Safing Procedures.** The ground system shall support the implementation of NICMOS safing procedures.	SMGT-**22,23,25**
F.2.1.3.2.3.3	**NICMOS Limits.** The ground system shall support the implementation of NICMOS limits.	SMGT-**22,23,25**

F.2.1.3.3.1	**Science Instrument Configurations. The ground system science systems shall support all valid Science Instrument configurations prior to, during, and following SM2.**	**SMGT-21**
F.2.1.3.3.2	**Dynamic Switch Capability. The ground system mission systems shall support a dynamic switch capability to support all valid ORU/ORI configurations and flight software configurations prior to, during, and following SM2.**	**SMGT-23,27**
F.2.1.3.3.3	**Seven Possible Science Instruments in the Project Data Base. The Project Data Base shall support seven possible Science Instruments: Faint Object Camera (FOC), Faint Object Spectrograph (FOS), GHRS, COSTAR, Wide Field Planetary Camera-II (WFPC-II), STIS, and NICMOS.**	**SMGT-21,23,24,25,27**
F.2.1.3.3.4	**ORI/ORU and Flight Software in the Project Data Base. The Project Data Base shall contain all ORI/ORU and Flight Software in the Project Data Base flight software data necessary to support all valid flight hardware and software configurations that the HST may be in prior to, during, and following SM2.**	**SMGT-22,23, ALL H/W**
F.2.1.3.3.5	**Changing Flight Configuration. The ground system and operations supporting real-time operations shall be able to complete the change from one flight configuration to another in no more than five minutes.**	**SMGT-21,23,27**
F.2.1.3.3.6	**Support Operational and Development PDB. The ground system shall have the capability to support an operational and development PDB for both flight operations and the SM2.**	**SMGT-21**

F.2.1.3.3.7	**Processing Any Combination of ORUs/ORIs. The ground system shall provide for a transition from processing Astrometry Engineering Data Processing (AEDP) data containing the existing hardware to any combination of ORUs/ORIs within five minutes.**	**SMGT-21,22,23**
F.2.1.3.3.8	**Generating and Displaying an Integrated Timeline. The ground system shall be capable of generating and displaying an integrated timeline of planned SM2 activities. It shall provide the capability to replan and update the timeline in the event of changes made during the execution of the SM2 within 30 minutes.**	**SMGT-23**
F.2.1.3.3.9	**Generating and Displaying a Graphic Timeline. The ground system shall be capable of generating and displaying a graphic timeline containing a combination of existing hardware and ORU/ORIs during ground simulations and on-orbit SM2 activities.**	**SMGT-22,23**
F.2.1.3.4.1	**Verify All Phases of SM2. Simulation capabilities shall be provided to verify all phases of SM2, including contingency procedures, prior to launch.**	**SMGT-21,22,23**
F.2.1.3.4.2	**Verification of Ground Software. Simulation capabilities shall be provided to verify ground software.**	**SMGT-21,22,23**
F.2.1.3.4.3	**Verification of Flight Software. Simulation capabilities shall be provided to verify flight software.**	**SMGT-21,22,23**
F.2.1.3.4.4	**Verification of Command Sequences. Simulation capabilities shall be provided to verify command sequences.**	**SMGT-21,22, 23**

F.2.1.3.4.5	**Verification of Operational Procedures. Simulation capabilities shall be provided to verify operational procedures for the new ORUs/ORIs and existing spacecraft subsystems prior to launch and during normal operations following SM2.**	**SMGT-21,22, 23**
F.2.1.3.4.6	**Support Telemetry Responses for All Combinations and Changeouts of ORU/ORI Configurations. The ground simulations shall have the capability to support the PDB defined telemetry responses for all combinations and changeouts of ORU/ORI configurations either by software, firmware, or hardware configuration.**	**SMGT-22,23**
F.2.1.3.4.7	**HST Ground System Interfaces. The HST ground system shall interface, for both data and voice, with the Vehicle Engineering System Test (VEST) facility, Simulations Operations Control (SOC), HST Simulator, ground and space networks, JSC, and KSC for test and simulations prior to launch.**	**IPA,ETE,PDT**
F.2.1.3.5.1	**Process 32 Kbps Engineering Data. The ground system shall be able to capture, collect, and process continuous 32 kbps engineering data during the Shuttle portion of the SM2 for a minimum of five days and a possible maximum of ten days.**	**SMGT-23,27**
F.2.1.3.5.2	**Process for Trending. The ground system shall be able to capture, collect, and process for trending, shuttle Payload Programmable Format (PPF) and Calibrated Ancillary System (CAS) thermal data during the shuttle phase of the SM2.**	**SMGT-22,23**
F.2.1.3.6.1.1	**SSR Start and Stop Sessions. Management of SSR RAM shall include maintaining information on the start/stop sequences that have been recorded, observation ID, and mode.**	**SMGT-22,28,32**

F.2.1.3.6.1.2	**Amount of SSR Data Recorded. Management of SSR RAM shall include maintaining information on the total amount of data recorded.**	**SMGT-22,28,32**
F.2.1.3.6.1.3	**Time required for SSR Playback. Management of SSR RAM shall include maintaining information on the amount of time required for playback.**	**SMGT-22,28,32**
F.2.1.3.6.1.4	**Monitoring Bad SSR Memory Areas. The ground system shall provide monitoring of bad SSR memory areas.**	**SMGT-23,32**
F.2.1.3.6.1.5	**Identification of Bad SSR Memory Areas. The ground system shall provide identification of bad SSR memory areas.**	**SMGT-32**
F.2.1.3.6.1.6	**Mapping Out of Bad SSR Memory Areas. The ground system shall provide mapping out of bad SSR memory areas.**	**SMGT-32**
F.2.1.3.6.2.1	**SSR Letter Code. The ground system shall support the SSR subsystem/letter code 'D'.**	**SMGT-22,27,32**
F.2.1.3.6.2.2	**SSR/ESTR Switching Capability. The PDB shall support a switching capability between the current ESTR configuration and the new SSR/ESTR configuration(s) in order for the ground system to properly identify the appropriate command and telemetry interfaces.**	**SMGT-22,23,27,32**
F.2.1.3.6.3	**SSR Health and Safety. The ground system shall support the implementation of SSR operating constraints and restrictions during real-time operations and the implementation of ground system limits in order to protect the unit(s) from damage.**	**Card Implementation Plan (SMO-1050)**
F.2.1.3.7.1.1	**Initialization Mode. The ground system shall support the implementation of real-time commanding capability to support the Initialization Mode (power on).**	**SMGT-34**

F.2.1.3.7.1.2	**Select Motor 1 or 2. The ground system shall support the implementation of real-time commanding capability to support selecting motor 1 or 2.**	**SMGT-34**
F.2.1.3.7.1.3	**Change Motor Direction. The ground system shall support the implementation of real-time commanding capability to support changing motor direction forward to reverse or reverse to forward.**	**SMGT-34**
F.2.1.3.7.1.4	**Moving Fold Flat 3 (FF3). The ground system shall support the implementation of real-time commanding capability to support moving Fold Flat 3 (FF3) n steps in the same direction as previous motion.**	**SMGT-34**
F.2.1.3.7.1.5	**Moving FF3 (After a Motor Direction Change). The ground system shall support the implementation of real-time commanding capability to support moving Fold Flat 3 (FF3) n steps following a command motor direction change.**	**SMGT-34**
F.2.1.3.7.1.6	**Monitor FF3 Moves. The ground system shall support software to monitor moves of the FF3.**	**SMGT-34**
F.2.1.3.7.1.7	**Process FGS S-Curve Data. The ground system shall support software to process FGS S-curve data.**	**SMGT-23**
F.2.1.3.7.1.8	**Compute Mechanism Motor Steps. The ground system shall support software to compute predicted actuator mechanism motor steps versus the processed S-curve data.**	**SMGT-34**
F.2.1.3.7.2	**FGS AMS Command and Telemetry Identifiers. The ground system shall support the unique command and telemetry identifiers defined for the FGS.**	**SMGT-34**

F.2.1.3.7.3	**FGS AMS Health and Safety. The ground system shall support the implementation of FGS AMS operating constraints and restrictions during real-time operations. The FGS AMS operating constraints and restrictions will be documented in SMO-1020.**	**Card Implementation Plan (SMO-1050)**
F.2.1.3.7.3.1	**FGS AMS Safing Procedures. The ground system shall support the implementation of FGS AMS safing procedures.**	**SMGT-34**
F.2.1.3.7.3.2	**FGS AMS Limits. The ground system shall support the implementation of FGS AMS limits.**	**SMGT-34**
F.2.1.4.1.1	**STIS Engineering Data Management.** The ground system shall support the receipt, processing, analysis, and archiving of all STIS engineering **telemetry** formats.	SMGT-21,24
F.2.1.4.1.2.1	**STIS Science Data.** The ground system shall support the receipt, processing, analysis, and archiving of all STIS science data.	SMGT-21,22,24
F.2.1.4.1.2.2	**STIS Diagnostic Engineering Data.** The ground system shall support the receipt, processing, analysis, and archiving of all STIS diagnostic engineering data.	SMGT-21,24
F.2.1.4.1.2.3	**STIS Memory dump Data.** The ground system shall support the receipt, processing, analysis, and archiving of all STIS memory dump data.	SMGT-21,22,24
F.2.1.4.2.1	**NICMOS Engineering Data Management.** The ground system shall support the receipt, processing, analysis, and archiving of all NICMOS engineering telemetry formats.	SMGT-21,23,25
F.2.1.4.2.2.1	**NICMOS Science Data.** The ground system shall support the receipt, processing, analysis, and archiving of all NICMOS science data.	SMGT-21,22,23,25
F.2.1.4.2.2.2	**NICMOS Diagnostic Engineering Data.** The ground system shall support the receipt, processing, analysis, and archiving of all NICMOS diagnostic engineering data.	SMGT-21,23,25

F.2.1.4.2.2.3	**NICMOS Memory Dump Data**. The ground system shall support the receipt, processing, analysis, and archiving of all NICMOS memory dump data.	SMGT-21,22,23,25
F.2.1.4.3.1.1	**Receipt, Processing, Analysis, and Archiving of SSR Engineering Telemetry Data. The ground system shall support the receipt, processing, analysis, and archiving of all engineering telemetry data produced by the various scientific instruments, OTA, and SSM hardware that has been recorded to the SSR hardware and subsequently played back to the ground.**	**SMGT-22,23,27,32**
F.2.1.4.3.1.2	**Identifying ESTR and SSR Playbacks of Engineering Telemetry Data. The ground system shall be capable of uniquely identifying ESTR and SSR playbacks of all engineering telemetry data.**	**SMGT-22**
F.2.1.4.3.1.3	**Forward and Reversed Order Engineering Telemetry Data. The ground system shall be capable of handling all engineering telemetry data in both forward and reversed order.**	**SMGT-22,23,27,32**
F.2.1.4.3.1.4	**Processing Bit Stuffed And Non-Bit Stuffed Engineering Data. The ground system shall be capable of processing both bit stuffed and non-bit stuffed engineering data.**	**SMGT-22,32**
F.2.1.4.3.1.5	**Retransmitting SSR Engineering Data. The ground system shall be capable of determining the need for and retransmitting blocks of engineering data in the event of data loss during the initial transmission.**	**SMGT-22,32**

F.2.1.4.3.2.1	**Receipt, Processing, Analysis, and Archiving of SSR Science Memory Dumps. The ground system shall support the receipt, processing, analysis, and archiving of all science memory dumps produced by the various scientific instruments, OTA, and SSM hardware that has been recorded to the SSR hardware and subsequently played back to the ground.**	**SMGT-22,23,32**
F.2.1.4.3.2.2	**Identifying ESTR and SSR Playbacks of Science Memory Dumps. The ground system shall be capable of uniquely identifying ESTR and SSR playbacks of science memory dump data.**	**SMGT-22,23,32**
F.2.1.4.3.2.3	**Forward and Reversed Order Science Memory Dump Data. The ground system shall be capable of handling science memory dump data both forward and reversed order.**	**SMGT-22,23,32**
F.2.1.4.3.2.4	**Processing Bit Stuffed And Non-Bit Stuffed Science Memory Dump Data. The ground system shall be capable of processing both bit stuffed and non-bit stuffed science memory dump data.**	**SMGT-22,23,32**
F.2.1.4.3.2.5	**Retransmitting SSR Science Memory Dump Data. The ground system shall be capable of determining the need for and retransmitting blocks of SSR science memory dump data in the event of data loss during the initial transmission.**	**SMGT-22,23,32**
F.2.1.4.3.3	**SSR Diagnostic Data. The ground system shall support the receipt, processing, analysis, and archiving of all SSR diagnostic data transmitted through the engineering telemetry.**	**SMGT-22,23,32**

F.2.1.5	**Ground System Verification.** All ground system elements shall be acceptance tested to **e**nsure compliance with Level III and IV requirements to support HST operations and SM2 activities prior to, during, and following SM2. **Acceptance testing activities shall include verification of all new capabilities, integration of new capabilities with existing capabilities, and regression testing to insure that existing capabilities have not been compromised by the addition of new capabilities.**	**HSTOMS ITAV Plan SMR-1041**
F.2.2.1.1.1	**NSSC-1 Flight Software Switching.** The NSSC-1 F**light** S**oftware** system shall support switching to an instrument configuration within specified servicing mission parameters.	**SMGT-24,25,27**
F.2.2.1.1.2	**NSSC-1 Support For Five of the Seven Possible SIs.** The NSSC-1 FSW system shall be able to support five of the seven possible SIs, i.e. FOC, FOS, GHRS, COSTAR, WFPC-II, STIS, and NICMOS.	**SMGT-24,25,27**
F.2.2.1.1.3	**NSSC-1 Flight Software Support for Normal Science Operations and SM2 Operations.** The NSSC-1 F**light Software** shall be able to support the transitions from normal science operations to SM2 operations and back to science operations.	**SMGT-27**
F.2.2.1.1.4	**Acceptance Testing of the NSSC-1 Flight Software.** Acceptance testing of the NSSC-1 Flight Software shall include testing of all new software, as well as integration tests and regression tests on the NSSC-1 Flight software for proper operation.	**NSSC-I Acceptance Test Report**

F.2.2.1.2.1	**NSSC-1 Processing of STIS Engineering Data Items.** The NSSC-1 FSW shall have engineering data items from a selectable table checked against their associated limits, and when **an engineering data item is** out of limits for a consecutive number of times, the STIS safing sequence shall be **issued by the NSSC-1**.	**SMGT-22**
F.2.2.1.2.2	**NSSC-1 Processing of Take-Data-Flag to STIS.** The NSSC-1 FSW shall retrieve and forward the HST Take-Data-Flag to STIS.	**SMGT-22**
F.2.2.1.2.3.1	**NSSC-1 Processing of STIS Requests for Small Angle Maneuvers**. The NSSC-1 F**light Software** shall process and respond to STIS requests for small angle maneuvers.	**SMGT-22**
F.2.2.1.2.3.2	**NSSC-1 Processing of STIS Requests for Executive Status Buffer Messages**. The NSSC-1 Flight Software shall process and respond to STIS requests to post messages in NSSC-1 Executive Status Buffer.	**SMGT-22**
F.2.2.1.2.3.3	**NSSC-1 Processing of STIS Requests to Suspend or Safe.** The NSSC-1 F**light Software** shall process and respond to requests to command STIS to a safe or to a suspend state.	**SMGT-22**
F.2.2.1.2.4	**NSSC-1 Processing of STIS Input Buffer Data**. The NSSC-1 **Flight Software** shall process STIS input buffer data fields into normal relative time commands.	**SMGT-22,24**
F.2.2.1.3.1	**NSSC-1 Processing of NICMOS Engineering Data Items.** The NSSC-1 **Flight Software** shall have engineering data items from a selecte**d** table checked against their associated limits, and when **an engineering data item is** out of limits a consecutive number of times, the NICMOS safing sequence shall be issued by the NSSC-1.	**SMGT-22**

F.2.2.1.3.3.1	**NSSC-1 Processing of NICMOS Requests for Small Angle Maneuvers**. The NSSC-1 **Flight Software** shall process and respond to NICMOS requests for small angle maneuvers.	**SMGT-22**
F.2.2.1.3.3.2	**NSSC-1 Processing of NICMOS Requests for Executive Status Buffer Messages**. The NSSC-1 **Flight Software** shall process and respond to NICMOS requests to post messages in NSSC-1 Executive Status Buffer.	**SMGT-22**
F.2.2.1.3.3.3	**NSSC-1 Processing of NICMOS Requests to Suspend or Safe**. The NSSC-1 **Flight Software** shall process and respond to requests to command NICMOS to a safe or to a suspend state.	**SMGT-22**
F.2.2.1.3.4	**NSSC-1 Processing of NICMOS Input Buffer Data**. The NSSC-1 **Flight Software** shall process NICMOS input buffer data fields into normal relative time commands.	**SMGT-22,25**
F.2.2.2.1	**Acceptance testing of the SSM Flight Software**. Acceptance testing of the SSM **Flight Software** shall include testing of all new software, as well as integration tests and regression tests on the SSM **Flight software** for proper operation.	**SM2 FSW Version Test Report**
F.2.2.2.2	**SSM Flight Software System Support for Safing**. The SSM **Flight Software** system shall support the proper safing of the existing payload and the STIS and NICMOS instruments upon installation such that safemode protection is always available for the correct complement of instruments.	**SMGT-24,25**
F.2.2.2.3	**SSM Flight Software Support of Timeline Activities**. The SSM **Flight Software** shall provide the capability through stored program command macros to pre-configure the flight software **and perform time-critical command activities** in support of timeline activities.	**SMGT-23,27**

F.2.2.2.5	**SSM Flight Software Support for SSR Safing. The SSM Flight Software shall support the proper safing of the SSRs upon installation such that the safemode protection is always available. Provisions in the safing design and the SSR hardware design shall be made to allow for placing the SSR(s) in a standby mode vice power off since SSR RAM is volatile and loss of power would result in loss of engineering and/or science data.**	**SMGT-32**
F.2.2.2.6	**SSM Flight Software Support for Verification of SSR Health and Safety and Scheduling of Activities. The SSM Flight Software shall support the command and telemetry interfaces between the SSM and the SI Flight computers necessary for proper scheduling of activities and verification of the health and safety of the SSR(s).**	**SMGT-22,32**
F.2.2.2.7	**SSM Flight Software Support for Serial Digital Sync Pulse to the SSR. The SSM Flight Software shall provide a serial digital sync pulse to the SSR for synchronization of SSR telemetry output. This sync pulse may be varied based on the telemetry format to allow for output of the SSR diagnostic data.**	**SMGT-22,27,32**
F.2.2.2.8	**SSR and ESTR Commanding of Science Records. The SSM Flight Software shall accommodate the differences between the SSR and the ESTR in commanding of science records.**	**SMGT-22,27,32**
F.2.2.2.9	**SSM Flight Software Support for Normal Science Operations and SM2 Operations. The SSM Flight Software shall be able to support the transitions from normal science operations to SM2 operations and back to science operations.**	**SMGT-23**
F.2.2.2.10	**SSM Flight Software Support for Gyro Configurations. The SSM Flight Software shall support nominal configuration loads for all possible gyro configurations.**	**SMGT-23**

F.2.3.1	**Operational Procedures**. Operational procedures shall be developed to allow replacement flight hardware to be subjected to aliveness and functional tests as soon after installation on the HST as possible. **The procedures shall permit the aliveness test to be completed within the same EVA period and the functional test within the next sleep period.**	SMGT-23 All Hardware
F.2.3.2	**Normal Science Operations.** Normal operations of the HST shall not be interrupted before the SM2 **has successfully launched. Planning and execution of the HST science mission shall continue in case of launch delays for any reason.**	SMGT-23
F.2.3.3	**Command Blocks in Operational Procedures.** All operational procedures without exception shall be composed entirely of command blocks that have been verified either by analysis, simulations, and/or with actual hardware.	SMGT-23,**28 All Hardware**
F.2.4.1.1	**Verification of Ground and Flight Software Functions.** A test and simulations program shall **be developed and implemented which verifies the O&GS Project's readiness to support the** verification of existing and new ground system and flight software functions.	**O&GS Operations Test Plan SMR-2043 SM2 Training and Simulation Plan SMR-2070 HSTOMS ITAV Plan SMR-1041**
F.2.4.1.2	**Verification of SM2 Timelines and Operational Procedures.** A test and simulations program shall **be developed and implemented which verifies the O&GS Project's readiness to support the** verification of all SM2 timelines and operational procedures before being baselined as part of the operational procedure. **All key operational procedures, timelines, and sequences intended to be used after HST release from the Shuttle shall be verified before launch.**	**O&GS Operations Test Plan SMR-2043 SM2 Training and Simulation Plan SMR-2070 HSTOMS ITAV Plan SMR-1041**

F.2.4.1.3	**Verification of Compatibility.** A test and simulations program shall **be developed and implemented which verifies the O&GS Project's readiness to support the** verification of compatibility across ground system, flight system, flight hardware, and SM2 timelines and operational procedures.	**O&GS Operations Test Plan SMR-2043 SM2 Training and Simulation Plan SMR-2070 HSTOMS ITAV Plan SMR-1041**
F.2.4.1.4	**Verification of Ground/Space Network Operational Interfaces. A** test and simulations program shall **be developed and implemented which verifies the O&GS Project's readiness to support the** verification of all ground/space network operational interfaces supporting SM2.	**O&GS Operations Test Plan SMR-2043 SM2 Training and Simulation Plan SMR-2070 HSTOMS ITAV Plan SMR-1041**
F.2.4.1.5	**Verification of Voice and Data Communications. A** test and simulations program shall **be developed and implemented which verifies the O&GS Project's readiness to support the** verification of all voice and data communications between the facilities and centers supporting SM2.	**O&GS Operations Test Plan SMR-2043 SM2 Training and Simulation Plan SMR-2070 HSTOMS ITAV Plan SMR-1041**
F.2.4.2.1	**Certification of All New Command and Telemetry Items. The Project Database** shall **only contain verified and certified** command and telemetry items for SM2 either by analysis, simulations, and/or with the new flight hardware **(during ground test activities)** before being used for flight operations. **Verification with flight hardware shall include actual issuance of telemetered information by the mission operations ground system.**	

F.2.4.2.2	**Certification of All New Command Sequences**. **The Project Database** shall only contain verified and certified sequences for SM2. PDB certification shall include all new command sequences for SM-2.	
F.2.4.3	**CARD Implementation Plan (SMO-1050)**. A CARD Implementation Plan (SMO-1050) shall be developed and implemented which verifies compliance with all CARD items.	**Card Implementation Plan (SMO-1050)**

F.2.5	OBSERVATORY VERIFICATION **The Servicing Mission Observatory Verification (SMOV) period starts when the HST is released from the Orbiter and encompasses those activities required to re-enable science observing with the HST. The goal of this program is to safely and quickly return HST to normal science operations with specific on-orbit checkout planned only for those subsystems and instrument packages directly affected by servicing. Those subsystems and capabilities that are not expected to be affected by servicing will be examined by the SMOV Planing Team with contingency plans and observations developed for system level or critical path activities in the event that the assumed capabilities are not available.** **During the SMOV period there will be no planned, unnecessary exercising of the instruments and subsystems (*i.e., activation of modes not planned for use in normal operation) which specifically precludes activities such as switching to redundant signal paths or activation of fail-safe mechanisms to verify that they work. As much as possible, engineering requirements will be verified by monitoring and trend analysis of otherwise-motivated activities**	**SMOV Plan**